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Kansas Entomological Society
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NEW SPECIES OF ENITHARES
(Hemiptera, Notonectidae)

GEORGE T. BROOKS

While preparing a forthcoming monograph of the genus **Enithares** Spinola under the direction of Dr. H. B. Hungerford, I discovered several species heretofore undescribed.

The color pattern for the species of this genus in highly variable, there being forms ranging from light to dark in the majority of species. Though in some instances only one color pattern is described, others may exist, as my color descriptions are based only on specimens at my disposal.

The first tarsal segment used throughout this paper in structural characterization is actually tarsal segments one plus two. The basal tarsal segment is very small and not always evident. Tarsal segment two is actually the third.

The specimens studied came from many different museums and these museums will be indicated according to the following legend: Snow Entomological Collections—S. E. C., United States National Museum—U. S. N. M., Paris Museum—P. M., Harvard Museum of Comparative Zoology—H. M., Carnegie Museum—C.M., Naturhistorisches Museum at Basel, Switzerland —B. M., Indian Museum at Calcutta, India—I. M., and the British Museum —Br. M.

The new species are described below.

Enithares stridulata n. sp.
Plate 1, figure 1

Size: Large robust species; length 11.4 mm. to 13.2 mm.; width of pronotum 4.5 mm. to 5.4 mm.

Color: Variable, light and dark forms. **Dark form:** eyes dark brown; vertex light brown; pronotum same color as vertex with a dark brown transverse band immediately behind the head, posterior margin appearing black as it is hyaline and overlies the black anterior margin of the scutellum; scutellum black, with or without a light brown triangular stripe on each side of the apical half; hemelytra dark brown or black with longitudinal hyaline bands extending for indefinite lengths from the base. **Light form:** eyes light brown or dark brown; vertex light brown; hemelytra light brown and faintly hyaline; clear zone of hemelytral membrane may be dark brown. Legs of both forms testaceous. Abdominal venter of both forms dark brown or testaceous; if the former, the keel and lateral margins are testaceous.

Structural Characteristics: As viewed from above the anterior margin of the head is almost straight with its anterio-lateral corners rounded; head short and its width much narrower than that of the pronotum; vertex with

* Contribution from the Department of Entomology, University of Kansas.

its anterior width slightly more than its length; synthlipsis wide, more than one-half as wide as the anterior width of the vertex; along the median longitudinal axis the head is shorter than the pronotum. Pronotum more than three times as wide as its median length with its anterior lateral margins broadly rounded; posteror margin of pronotum concave; dorsal margin of pronotal fovea slanting laterally from behind the eyes. Nodal furrow may be slanting or curved forward and equal to or slightly more than its length removed from the membranal suture. Males with the apex of the clavus slightly raised and roughened by numerous pits. Mesotrochanter angulate. Metaxyphus with its basal lateral margins curved and converging; apical lateral margins almost straight and parallel; apex of metaxyphus truncate with the apical margin at right angles to the apical lateral margins. Anterior tibia of males with a slightly concave indentation on its anterior margin just below the middle. A row of small black transverse ridges extends along the apical posterior margin of the middle tibia and posterior margin of the tarsus of the males. Male genital capsule as shown on Plate I, figure 1. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	122	32	15
Male middle leg	100	81	40	17
Female front leg	100	109	37	20
Female middle leg	100	81	39	18

Location of Types: Holotype ♂, allotype ♀, 4 ♂ and 5 ♀ paratypes, Indo-China, Luang Prabang, Ban Sambang, November 20, 1918, R. V. de Salvaza, in the British Museum. One ♂ and 1 ♀ paratypes, same collector, place, and date, in the Snow Entomological Collections.

Comparative Notes: Similar to **E. lineatipes** Horvath but much larger. Males of **E. lineatipes** lack the raised claval apex and ridges of middle tibia and tarsus.

Data on Distribution: In addition to the type series.

Indo-China

Luang Probang, Muong You, Nov. 13, 1917, R. V. de Salvaza; 1 ♀ (Br. M.)
Tonkin, Chapa, June 1916, R. V. de Salvaza; 1 ♀ (Br. M.)
Laos, Xieng Khouang, Dec. 23, 1918, R. V. de Salvaza; 2 ♂♂ (Br. M.)
Laos, Xieng Khouang, Ben Sai, March 1919, R. V. de Salvaza; 1♀ (Br. M.)
Luang Prabang, Sala Man Pik, Mar. 27, 1918, R. V. de Salvaza; 1 ♂ (Br.M.)

Enithares metallica n. sp.
Plate I, figure 2

Size: Length 10.2 mm. to 11.5 mm.; width of pronotum 3.9 mm. to 4.1 mm.

Color: Variable, light and dark forms. **Light form:** eyes grayish brown; vertex light brown; pronotum same color as vertex, may have a slightly darker transverse band immediately behind the eyes; scutellum light brown; hemelytra light brown with longitudinal hyaline areas extending from base

and these may appear darker due to the dark body surface underneath, clear zone of membrane dark brown; legs testaceous; ventral abdominal sclerites light brown with keel and lateral margins testaceous. **Dark form:** Eyes light brown or brown; vertex stramineous, anterior margin may be tinged with red; pronotum with anterior portion light gray, separated from white posterior portion by a line of dense punctations, posterior margin may be hyaline and if so, appears black as it overlies the black anterior margin of the scutellum; scutellum stramineous with anterior margin black; hemelytra dark brown, almost black with uneven longitudinal flavus stripes radiating from the base along the lateral margins and outer margins of clavus, lateral margins of hemelytra may be hyaline; legs testaceous, ventral abdominal sclerites dark brown with keel and lateral margins light brown.

Structural Characteristics: As viewed from above the head is short with the anterior outline rounded; vertex with its width greater than its length; synthlipsis wide, over one-half the anterior width of the vertex; along the median longitudinal axis the head is shorter than the pronotum. Pronotum with width more than three times its median length; posterior margin concave; dorsal margin of pronotal fovea directed laterally from behind the eyes. Nodal furrow curved forward or slanting forward and less than its length removed from the membranal suture. Metaxyphus with basal lateral margins slightly curved convexly and apical oblique lateral margins meeting in a short pointed apex. Male genital capsule as on Plate I, fig. 2. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	113	46	23
Male middle leg	100	84	33	17
Female front leg	100	108	44	24
Female middle leg	100	84	34	18

Location of Types: Holotype ♂, allotype ♀, and 1 ♂ paratype, Siam, 1924, Hugh Smith, in the United States National Museum; 1 ♂ and 1 ♀ paratypes, same place, collector, and date, in Snow Entomological Collections.

Comparative Notes: Although somewhat smaller than **E templetoni** (Kirby), this species resembles it very closely. Both have short broad heads and their lateral body outlines converging from the posterior margins of the pronotum. These two species can be readily separated, however, as the metaxyphus of **E. metallica** has its basal lateral margins slightly curved convexly and these curve gradually into the apical oblique margins whereas in **E. templetoni** the basal lateral margins are raised and curved concavely; these bend abruptly into the apical oblique margins and the angle there formed is thickened and appears nodule-like.

Data on Distribution: In addition to the type series.

Malay Peninsula

Perak, 7 miles south Taiping, waterfall in still sandy pool, July 3, 1937, 1 ♂, 2 ♀♀ (Br. M.).

Teku River, 4500 ft., Dec. 13, 1921, 2 ♂♂, 1 ♀ (Br. M.).
Wraip Camp, 3300 ft., Dec. 10, 1921, 1♀ (Br. M.)

Siam

Bulsit Besar, 2 ♀♀ (Br. M.).

Indo China

Tonkin, Hoabinh, Jan. 1917, R. V. de Salvaza, 2 ♂♂, 2 ♀♀ (Br. M.).

Enithares bakeri n. sp.
Plate I, figure 3

Size: Small robust species; length 7.8 mm. to 8.1 mm.; width of pronotum 2.7 mm.

Color: Eyes dark brown or brown; vertex and remainder of dorsal surface of body light brown; legs and abdominal venter testaceous; abdominal venter may be dark brown with keel and lateral margins testaceous.

Structural Characteristics: Head long and broad with its anterior margin rounded; vertex with its anterior width less than its length; synthlipsis wide, at least one-half as wide as the anterior width of the vertex; along the median longitudinal axis the head is longer than the pronotum. Pronotum with its width more than three times its length; posterior margin of pronotum almost straight; pronotal fovea with its dorsal margin curving laterally from behind the eyes. Nodal furrow directed dorsad and more than its length removed from the membranal suture. Mesotrochanter angulate. Metaxyphus with basal lateral margins almost straight and parallel; apical oblique lateral margins straight and converging, meeting in a pointed apex. Male genital capsule as shown on Plate I, figure 3. The relative lengths of the parts of the legs are as followes:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	101	43	16
Male middle leg	100	82	32	12
Female front leg	100	103	38	19
Female middle leg	100	82	33	22

Location of Types: Holotype ♂, allotype ♀, 3♂♂ and 5♀♀ paratypes, Surigao, Mindanao, Baker, in the United States National Museum; 1 ♂ and 1 ♀ paratypes, same place and collector, in the Snow Entomological Collections.

Comparative Notes: This species resembles **E. sinica** Stål in general body contours though somewhat smaller. The males of this species lack the femoral spur as found on the hind femur of **E. sinica.** Also in this species the head is distinctly longer than the pronotum whereas in **E. sinica** the head is shorter than the pronotum.

Data on Distribution: Known only from type series.

Enithares malayensis n. sp.
Plate I, figure 4

Size: Length 9 mm. to 9.3 mm.; width of pronotum 3.3 mm. to 3.6 mm.

Color: Eyes brown, vertex light brown; pronotum same color as vertex; scutellum dark brown with a lateral triangular dark brown patch on each side, meeting in the apex to form a "V". Hemelytra dark brown or black with hyaline areas that appear black due to the dark body surface underneath. Legs and abdominal venter testaceous, the latter may be unevenly colored dark brown.

Structural Characteristics: As viewed from above the head is short with its anterior margin rounded; vertex with its anterior width greater than its length; synthlipsis wide, equal to one-half the anterior width of the vertex; along the median longitudinal axis the head is much shorter than the pronotum. Pronotum less than three times as wide as its median length; posterior margin concave; dorsal margin of pronotal fovea curving laterally from behind the eyes. Nodal furrow curved forward and less than its length removed from the membranal suture. Anterior tibia curved forward being concave on its anterior margin and convex on its posterior margin, also heavily haired along lower anterior margin. Middle tibia of males swollen to form a convex arch along the dorsal surface; expanded at its apex to form a short triangular eminence along the anterior basal fifth of the tarsus, this expansion also provided with a short ventrally directed spur at its base. Mesotrochanter forms a distinct spur at the inner ventral angle. Metaxyphus with basal lateral margins straight and converging, apical oblique margins straight and meeting in a point. Male genital capsule as on Plate I, figure 4. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	102	43	18
Male middle leg	100	98	67	21

Location of Types: Holotype ♂, Kedah Peak 2900 ft., Malay Peninsula, Dec. 2, 1915, in the British Museum; 1 ♂ paratype, same place and date, in the Snow Entomological Collections.

Comparative Notes: This species strongly resembles **E. abbreviata** (Kirby) but can be quickly separated from the latter as the males have a mestotrochanteral spur which is lacking on **E. abbreviata.** The males of this species also lack the patch of small black spicules on the anterior surface of the mesotrochanter and the first tarsal segment of the middle leg is distinctly longer than the second whereas **E. abbreviata** has the above mentioned mesotrochanteral spicules and has the first tarsal segment much shorter than the second.

Data of Distribution: Known only from type series.

Enithares hungerfordi n .sp.
Plate I, figure 5

Size: Length 13.2 mm. to 16.8 mm.; width of pronotum 5.4 mm. to 6mm.

Color: Variable, light and dark forms. **Light form:** eyes grayish brown,

brown or dark brown; vertex stramineous; pronotum same color as vertex with posterior margin hyaline and appearing brown as it allows the brown color of the underlying portion of the scutellum to be seen; scutellum and hemelytra light brown or stramineous; the hemelytra may be partly or wholly hyaline. **Dark form:** eyes grayish brown; vertex light brown; pronotum immediately behind the eyes dark brown, followed by a transverse band the same color as the vertex, which may be hyaline on its posterior margin and appear black due to the underlying black portion of the scutellum; scutellum black with a lateral flavus stripe on each side; hemelytra black with basal half of corium and clavus irregularly colored with brown. Both forms have legs testaceous and ventral abdominal segments dark brown with keel and lateral margins light brown.

Structural Characteristics: As viewed from above the anterior outline of the head is rounded; head short; vertex with its anterior width greater than its length; synthlipsis wide, more than one-half as wide as the anterior width of vertex; along the median longitudinal axis the head is shorter than pronotum. Pronotum at least three tmes as wide as long; posterior margin only slightly concave, almost straight; dorsal margin of pronotal fovea curving laterally from behind the eyes. Nodal furrow curved forward and less than its length removed from the membranal suture. Hind femur of males with a black nodule on lower posterior margin. Mesotrochanter angulate. Metaxyphus with basal lateral margins almost straight, only slightly curved; apical oblique lateral margins straight and meeting in a point. Male genital capsule as shown on Plate I, figure 5. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	110	38	14
Male middle leg	100	86	38	22
Female front leg	100	105	41	17
Female middle leg	100	84	40	24

Location of Types: Holotype ♂, allotype ♀, a small stream below Jumma Cottage, Kodaikanal, Palni Hills, S. India, October 7, 1925, S. L. Hora, in the Indian Museum at Calcutta; 1 ♂ and 1 ♀ paratypes, same place, collector, and date, in the Snow Entomological Collections.

Comparative Notes: Of the same shape and size as **E. triangularis** (Guérin-Meneville) and resembles it very closely. However, the males of **E. hungerfordi** have a more pronounced tubercle on the hind femur and it is located more on the ventral surface than the similar tubercle of **E. triangularis**. Also the males of the latter species possess a short triangular eminence on the ventral surface of the anterior femur. This eminence is lacking on the anterior femur of the males of **E. hungerfordi.**

Data on Distribution: In addition to the type series.

India

Kodaikanal, Palni Hills, S. India, S. Kemp, August 1922, 3 ♂♂, 6 ♀♀ (I.M.), 2 ♂♂, 6 ♀♀ (S.E.C.); T .V. Campbell, 1 ♂ (S.E.C.) 2♀♀ (Br. M.).

Kodaikanal, S. India 7000 ft., March 27, 1936, 1 ♂, 6 ♀♀ (Br. M.)
Pulvachi River, Palni Hills, S. India, S. Kemp, 1 ♀ (I.M.).
Inde Mere, Madura, Jos Dubreuil, 2 ♂♂, 1 ♀ (I.M.) 1 ♂, 2 ♀♀ (S.E.C.).
India or Shembaganur, exchange fr. Horvath 2 ♂♂ (S.E.C.)
Inde Mere, Trichinopoly, Jos Dubreuil, 2 ♀♀, 2 ♂♂ (U.S.N.M.).
Trichinopoly, S. India, A. L. Montn, 1 ♂ (U.S.N.M.)
Naraikkadu, 2500 to 3000 ft., Tinnevelly Dt, S. India, March 9, 1936, 3 ♂♂, 5 ♀♀ (Br. M.).

Enithares chinensis n. sp.
Plate II, figure 1

Size: Length 10.2 mm. to 10.8 mm.; width of pronotum 3.3 mm. to 4 mm.

Color: Variable, light and dark forms. **Light form:** entire dorsal surface testaceous with eyes brown. **Dark form:** eyes brown; vertex light brown; pronotum and hemelytra dark brown with the anterior lateral margins of the latter testaceous and faintly hyaline. Legs of both forms testaceous; ventral abdominal segments dark brown with keel and lateral margins testaceous.

Structural Characteristics: As viewed from above the head is broad with its anterior outline rounded; vertex with its anterior width greater than its length; synthlipsis wide, at least one-half the anterior width of the vertex; along the median longitudinal axis the head is slightly shorter than the pronotum. Pronotum at least three times as wide as its median length; posterior margin almost straight, only slightly concave; dorsal margin of the pronotal fovea curving laterally from behind the eyes. Nodal furrow straight and directed dorsad, more than its length removed from the membranal suture. Mesotrochanter rounded. Metaxyphus with basal lateral margins straight and almost parallel, apical oblique lateral margins curved concavely and meeting in a pointed apex. Male genital capsule as shown on Plate II, figure 6. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	107	37	18
Male middle leg	100	83	33	18
Female front leg	100	111	38	18
Female middle leg	100	91	32	17

Location of Types: Holotype ♂, Datchulan, China, 1939, T. H. Cheng, in the United States National Museum; allotype ♀ and 1 ♂ paratype, Foochow, China, Chenfu F. Wu, in the Imperial Museum in Japan.

Comparative Notes: This species is about the same size and shape as **E. lineatipes** Horvath. However, the anterior outline of the head is rounded whereas the anterior outline of the head of **E. lineatipes** is more or less straight with only the anterior lateral corners rounded. The first tarsal segment of the front leg of both sexes is twice the length of the second whereas in **E. lineatipes** this is not true.

Data on Distribution: Known only from type series.

Size: Length 9 mm. to 10.5 mm.; width of pronotum 3.6 mm. to 4.2 mm.

Enithares buhleri n. sp.
Plate II, figure 7

Color: Variable, light and dark forms. **Light form:** eyes brown; vertex pale brown; pronotum, scutellum and hemelytra the same color as the vertex, the hemelytra may have hyaline areas that appear darker due to the underlying dark body surface; frons with two brown spots, one on each side of the median line; legs testaceous; ventral abdominal segments light brown with keel and lateral margins testaceous. **Dark form:** eyes grayish brown; vertex stramineous; pronotum with its anterior portion dark brown, hind portion same color as vertex; posterior margin of pronotum may be hyaline and appear black as it overlies the black anterior margin of the scutellum; scutellum black, may have two lateral flavus stripes, one on each side of apical half; hemelytra black, may have its lateral margins and basal half light brown and hyaline; frons with the brown spots as found on the light forms; legs testaceous; abdominal venter brown or dark brown, with keel and lateral margins testaceous.

Structural Characteristics: As viewed from above the head is short with its anterior outline rounded; vertex with its anterior width greater than its length; synthlipsis wide, at least one-half as wide as the anterior width of the vertex; along the median longitudinal axis the head is slightly shorter than the pronotum. Pronotum slightly more than three times as wide as its median length; posterior margin concave; dorsal margin of the pronotal fovea curves laterally from behind the eyes. Nodal furrow curves forward and is less than its length removed from the membranal suture. Base of the labrum with its lateral margins thickened, appearing almost rectangular. Anterior tibia of male slightly concave along its anterior margin and prolonged into a very short triangular process at the base of the first tarsal segment. Middle tibia of males with similar more pronounced prolongation at its anterior apical margin. These processes are present on the front and middle tibiae of the females but very much reduced. First tarsal segment of the middle leg of the male roughly triangular in shape, the base being almost twice as wide as the apex. Mesotrochanter of males with its free periphery set with short black bristles; mesotrochanter angulate. Hind trochanter of males with a dark brown nodule at its base next to the base of the femur. Femur of both sexes with a depression on its anterior surface, near the base, deeper in the males than in the females. Small black nodule on the lower posterior margin of the hind femur of the males; lower posterior margin of hind femur of males provided with long hairs. Metaxyphus with lateral margins medianly concave, apical margin rounded. Male genital capsule as shown on Plate II, figure 7. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	104	37	23
Male middle leg	100	91	36	26
Female front leg	100	97	42	25
Female middle leg	100	84	37	26

Location of Types: Holotype ♂, allotype ♀, 1 ♂ and 1 ♀ paratypes, Soe, Timor, June 1935, C. Buhler and Meyer, in the Naturhistorisches Museum at Basel, Switzerland; other paratypes as follows: 1 ♂, Baaguia, Timor, Aug. 1935, C. Buhler and Meyer, in Naturhistorisches Museum at Basel, Switzerland; 1 ♂, Baaguia, Timor, August 1935, C. Buhler and Meyer; 2 ♀♀, Soe, Timor, June 1935, C. Buhler and Meyer; 1 ♂, Molle, Timor, 1935, Buhler, in the Snow Entomological Collections.

Comparative Notes: Although much larger than **E. gibbera** n. sp. the shape of the legs give it a close resemblance to this species. The triangular process on the anterior leg of the male of **E. gibbera** is longer than that of **E. buhleri** and the anterior margin of the first tarsal segment of the middle leg of the male is not convex as in **E. gibbera**, but straight. The apex of the metaxyphus of **E. buhleri** is rounded while that of **E. gibbera** is acuminate.

Data on Distribution: Known only from type series.

Enithares loria n. sp.
Plate II, figure 8

Size: Length 6 mm. to 6.9 mm.; width of pronotum 2.4 mm.

Color: Eyes reddish brown or brown; vertex light brown; pronotum with its anterior half same color as vertex, posterior half hyaline and appearing brown due to the brown underlying portion of the scutellum; scutellum brown; hemelytra tan and partly or wholly hyaline; legs stramineous; abdominal venter dark brown with keel and lateral margins testaceous.

Structural Characteristics: As viewed from above the anterior outline of the head is rounded, with its anterior width equal to its length; synthlipsis narrow, slightly less than one-half the anterior width of the vertex; along the median longitudinal axis the head is equal to or slightly longer than the pronotum. Pronotum at least three times as wide as its median length; posterior margin of pronotum straight or only slightly concave; dorsal margin of pronotal fovea curves laterally from behind the eyes. Nodal furrow directed more or less dorsad and less than its length removed from the membranal suture. When viewed ventrally the frons has two depressions, one on each side next to the eyes; immediately below these are two more medianly located depressions. Mesotrochanter angulate. Metaxyphus with its basal lateral margins convexly curved, apical oblique margins almost straight and meeting in a point. Male genital capsule as shown on Plate II, figure 8. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	100	37	16
Male middle leg	100	84	32	24
Female front leg	100	100	36	18
Female middle leg	100	83	36	19

Location of Types: Holotype ♂, allotype 1 ♀, 2 ♂♂ and 1 ♀ paratypes, New Guinea, Rigo, Luglio, 1889, L. Loria, in the United States National Mu-

seum; 1 ♂ and 1 ♀ paratypes, same place, collector and date, in the Snow Entomological Collections.

Comparative Notes: This species is about the same size as **E. mandalayensis** Distant and the light forms of the two species make them all the more similar. However, **E. loriai** has a vertex with its anterior width equal to its length, whereas **E. mandalayensis** has the anterior width of the vertex less than the length. The latter species also has the outer (or posterior) claw of the middle leg of the male thickened and decidedly bent inward. This condition is lacking on the males of **E. loriai.**

Data on Distribution: In addition to the type series.

Papua, Mafulu 4000 ft., December 1933, L. E. Cheeseman, 2 ♂♂ and 4 ♀♀ (Br. M.).

Australia, Adelaide River, 1 ♂ (Er. M.). J. J. Walker, 1 and 1 ♀ (Br. M.).

Enithares fusca n. sp.

Plate II, figure 9

Size: Length 8.7 mm. to 9 mm.; width of pronotum 3.6 mm.

Color: Variable, light and dark forms. **Light forms:** eyes dark brown; vertex, pronotum, scutellum and hemelytra flavus; clear zone of the membrane dark brown; frons with two brown spots on anterior margin, one on each side of the median line and with a dark brown spot above the labrum; legs testaceous. **Dark form:** eyes dark brown; vertex light brown; anterior portion of pronotum dark brown, posterior portion stramineous with its hind margin hyaline and appearing black as it overlies the black anterior margin of the scutellum; scutellum dark brown or black with two lateral flavus bands, one on each side, hemelytra dark brown or black with faintly gray hyaline stripes extending from base along lateral margins of hemelytra and corium; frons with same brown areas as the light form; legs testaceous; abdominal venter dark brown with keel and lateral margins testaceous.

Structural Characteristics: As viewed from above the head is short with its anterior outline only slightly rounded; vertex with its anterior width greater than its length; synthlipsis wide, at least one-half as wide as anterior width of vertex; along the median longitudinal axis the head is shorter than the pronotum. Pronotum more than three times as wide as its median length; posterior margin concave; dorsal margin of pronotal fovea curves laterally from behind the eyes. Nodal furrow curved forward and less than its length removed from the membranal suture. Middle tibia of males with a black nodule on its inner surface at the apex. Hind femur of males with a small black nodule on the lower posterior margin. Mesotrochanter angulate. Metaxyphus with its basal lateral margins straight and converging; apical oblique lateral margins slightly concave and meeting in a pointed apex. Male genital capsule as shown on Plate II, figure 9. The relative lengths of the parts of the legs are as follows:

Male front leg	100	109	36	18
Male middle leg	100	92	30	18
Female front leg	100	104	36	18
Female middle leg	100	93	35	21

Location of Types: Holotype ♂, allotype ♀, 1 ♀ paratype, Parambikuiam, Cochin State, India, Sept. 16-24, 1914, in the Indian Museum at Calcutta; 1 ♂ and 1 ♀ paratypes, same place, collector and date, in the Snow Entomological Collections.

Comparative Notes: Though closely resembling **E. intricata** Breddin, this species is slightly larger. It is strongly convex across the pronotum both longitudinally and transversely, a condition that is lacking in **E. intricata.** The males of the latter species lack the nodules as found on the middle tibiae and hind femora of the males of **E. fusca.**

Data on Distribution: Known only from type series.

Enithares wallacei n. sp.
Plate II, figure 10

Size: Length 12.6 mm.; width of pronotum 4.2 mm.

Color: Eyes brown; vertex light brown; pronotum with anterior portion dark brown followed by a transverse stramineous band, posterior margin hyaline and appears dark brown or black due to the underlying dark margin of the scutellum; scutellum dark brown or black; hemelytra with basal half gray and hyaline and appears dark due to the dark body surface underneath, apical half dark brown; legs stramineous, ventral abdominal sclerites dark brown with keel and lateral margins stramineous.

Structural Characteristics: Head short and broad with its anterior outline rounded; vertex with its anterior width greater than its length; synthlipsis wide, over one-half as wide as the anterior width of the vertex; along the median longitudinal axis the head is shorter than the pronotum. Pronotum with its width three times its median length; posterior margin concave; dorsal margn of pronotal fovea curves laterally from behind the eyes. Nodal furrow curved forward at its tip and less than its length removed from the membranal suture. Mesotibia of males slightly concave along its anterior surface just before the apex. Metaxyphus with basal lateral margins almost straight and parallel; apical oblique margine slightly concavely curved and meeting in a pointed apex. Male genital capsule as shown on Plate II, figure 10. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	110	37	20
Male middle leg	100	88	28	23

Location of Type: Holotype ♂, Mak, Celeb., Wallace, in the British Museum.

Comparative Notes: This species is about the same length as **E. triangularis** (Guérin-Meneville) and also resembles it very closely in coloration. However, the male of this species lacks the short triangular eminence as found on the ventral surface at the base of the femur of the male of **E. triangularis.**

Data on Distribution: Known only from type specimen.

Enithares atra n. sp.
Plate III, figure 11

Size: Length 9 mm.; width of pronotum 3.6 mm.

Color: Eyes yellowish brown; vertex flavus; anterior half of pronotum of the same color as vertex, posterior half gray with hind margin hyaline, appears black as it overlies the black anterior margin of the scutellum; scutellum black or may be cream colored with only the anterior margin black; hemelytra dark brown with lighter hyaline brown bands on corium and on the suture between the clavus and corium; legs stramineous; ventral abdominal sclerites dark brown, with keel and lateral margins light brown.

Structural Characteristics: As viewed from above the head is short with the anterior outline rounded; vertex with its anterior width equal to its length; synthlipsis wide, at least one-half as wide as the anterior width of vertex; along the median longitudinal axis the head is shorter than the pronotum at least three times as wide as its median length; posterior margin of pronotum concave; dorsal margin of pronotal fovea slants laterally from behind the eyes. Nodal furrow slanting forward and less than its length removed from the membranal suture. Mesotrochanter rounded. Metaxyphus with basal lateral margins concave and diverging; apical oblique lateral margins slightly concave and meeting in a pointed apex. Male genital capsule as shown on Plate III, figure 11. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	100	36	20
Male middle leg	100	87	31	22
Female front leg	100	104	36	23
Female middle leg	100	84	32	22

Location of Types: Holotype ♂, allotype ♀, 2 ♂♂ and 1 ♀ paratypes, New Guinea, Rigo, Luglio, 1889, L. Loria, in the United States National Museum; other paratypes as follows: 2 ♂♂ and 1 ♀, same place, collector, and date, in the Snow Entomological Collections; 5 ♀♀, same place, collector, and date, in the United States National Museum.

Comparative Notes: This species approximately the same size as **E. abbreviata** (Kirby) but its head is a little shorter and broader in relation to the pronotum than that of **E. abbreviata.** The males of this species lack the short flattened first tarsal segment of the middle leg and the area of black spicules on the inner surface of the mesotrochanter as found on the males of **E. abbreviata.** The dorsal margin of the pronotal fovea of **E. atra** curves laterally from behind the eyes while that of **E. abbreviata** is directed more or less posteriorly from behind the eyes before turning laterally.

Data on Distribution: Known only from type series.

Enithares freyi n. sp.
Plate III, figure 12

Size: Length 11 mm.; width of pronotum 4.2 mm.

Color: Eyes brown; vertex stramineous; pronotum same color as vertex, with transverse dark brown band immediately behind the eyes, posterior margin of pronotum hyaline, appears dark brown due to the dark brown portion of the underlying scutellum; scutellum dark brown with apex and apical half of lateral margins stramineous; hemelytra dark brown; legs stramineous; abdominal venter dark brown with keel and lateral margins stramineous.

Structural Characteristics: As viewed from above the head is short and broad with its anterior margin rounded; vertex with its anterior width greater than its length; synthlipsis wide, at least one-half the anterior width of the vertex; along the median longitudinal axis the head is slightly shorter than the pronotum. Pronotum more than three times as broad as its median length; posterior margin concave; dorsal margin of pronotal fovea curves laterally from behind the eyes. Nodal furrow slanting forward and less than its length removed from the membranal suture. Mesotrochanter rounded. Metaxyphus with basal lateral margins convexly curved and converging slightly; apical oblique lateral margins concavely curved and meeting in a pointed apex. Male genital capsule as shown on Plate III, figure 12. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	97	36	21
Male middle leg	100	87	33	22

Location of Type: Holotype ♂, Mt. Prov. P. I. Benguet, July 15, 1946, Dr. G. Frey, in the British Museum.

Comparative Notes: This species resembles **E. lineatipes** Horvath being about the same length and width. However, the head is more rounded on its anterior margin and is wider in relation to the width of the pronotum than that of **E. lineatipes.** The nodal furrow in **E. freyi** is less than its length removed from the membranal suture,whereas in **E. lineatipes** the nodal furrow is more than or at least equal to its length removed from the membranal suture.

Data on Distribution: Known only from type specimen.

Enithares fruhstorferi n. sp.
Plate III, figure 13

Size: Length 10.2 mm.; width of pronotum 3.6 mm.

Color: Eyes brown; vertex light brown; pronotum with anterior half same color as vertex, followed by a darker band, posterior margin of pronotum hyaline and appears dark brown as it overlies the dark anterior portion of the scutellum; scutellum dark brown; hemelytra tan and hyaline; legs testaceous; ventral abdominal sclerites brown.

Structural Characteristics: As viewed from above the anterior outline of the head is rounded; head broad; vertex with its anterior width greater than its length; synthlipsis wide, slightly more than one-half the anterior width of the vertex; along the median longitudinal axis the head is slightly shorter

than the pronotum. Pronotum three times as wide as its median length; posterior margin almost straight, only slightly concave; dorsal margin of pronotal fovea directed more or less caudad before turning laterally. Nodal furrow curved forward and less than its length removed from the membanal suture. Mesotrochanter angulate. Metaxyphus with basal lateral margins slightly convex; apical oblique lateral margins concave and meeting in a pointed apex. Male genital capsule as shown on Plate III, figure 13. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	117	46	22
Male middle leg	100	86	34	23

Location of Type: Holotype ♂, Tenegger-Gebrig, Java, H. Fruhstorfer, in the United States National Museum.

Comparative Notes. This species is about the same size as **E. abbreviata** (Kirby) and resembles the light forms of the latter. However, this male specimen lacks the area of black spicules as found on the mesotrochanter of the latter. The first tarsal segment of the middle leg is not shortened and flattened as in **E. abbreviata.** Also the small tubercle as found on the hind femur of the males of **E. abbreviata** is not present in this species.

Data on Distribution: Known only from type specimen.

Enithares timorensis n. sp.
Plate III, figure 14

Size: Length 9.2 mm.; width of pronotum 3.5 mm.

Color: Variable, light and dark forms. **Light form:** Eyes brown; vertex and remainder of dorsal surface of body light brown; frons may be tinged with green; legs and abdominal venter testaceous, the latter may be dark brown with only the keel and lateral margins testaceous. **Dark form:** eyes dark brown; vertex stramineous; hind margin of pronotum hyaline and appears dark brown due to the dark brown color of the underlying scutellum; scutellum dark brown or black; hemelytra dark brown or black; legs testaceous; abdominal venter may be testaceous or dark brown.

Structural Characteristics: As viewed from above the anterior outline of the head is rounded; vertex with its anterior width less than its length; synthlipsis wide, equal to or more than one-half the anterior width of the vertex; along the median longitudinal axis the head is equal to the length of the pronotum. Pronotum three times as broad as its median length, posterior margin almost straight; dorsal margin of pronotal fovea curves laterally from behind the eyes. Nodal furrow slightly curved forward and equal to its length removed from the membranal suture. Mesotrochanter angulate. Metaxyphus with basal lateral margins almost straight, only slightly convex and converging; apical oblique lateral margins concave and meeting in a pointed apex. Male genital capsule as shown on Plate III, figure 14. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	112	41	20
Male middle leg	100	88	33	24
Female front leg	100	102	42	23
Female middle leg	100	85	35	23

Location of Types: Holotype ♂, allotype ♀, Soe, Timor, 1935, Buhler in the Naturhistorisches Museum at Basel, Switzerland; paratypes are as follows: 1 ♀, Soe, Timor, June 1935, C. Buhler and Meyer; 1 ♂, Bowo, Timor, in the Snow Entomological Collections; 1 ♂, Timor, in the British Museum.

Comparative Notes: This species resembles **E. bergrothi** Montandon very much and can best be distinguished from it by an examination of the male genital capsule. The male genital capsule of this species has a more or less oval shaped clasper, whereas the clasper of the male genital capsule of **E. bergrothi** has an ovally swollen base with the lateral margins tapering to form an extended acuminated apex.

Data on Distribution: Known only from type series.

Enithares gibbera n. sp.
Plate III, figure 15

Size: Length 8.8 mm. to 9 mm.; width of pronotum 3 mm. to 3.3 mm.

Color: Variable, light and dark forms. **Light form:** completely pale brown with eyes dark brown. **Dark form:** eyes brown; vertex stramineous; pronotum, immediately behind the eyed dark brown, followed by a transverse stramineous band, posterior margin of the pronotum may be hyaline and appearing black as it overlies the black anterior margin of the scutellum; scutellum black, may have two lateral triangular shaped flavus stripes, one on each side; hemelytra black with hyaline areas on clavus and corium; frons with two brown spots, one on each side of the median line and another brown spot immediately above the labrum; ventral abdominal segments dark brown; legs testaceous.

Structural Characteristics: As viewed from above the head is short and broad with its anterior outline rounded; vertex with its anterior width greater than its length; synthlipsis wide, at least one-half the anterior width of the vertex; along the median longitudinal axis the head is shorter than the pronotum. Pronotum with its width at least three times its median length; posterior margin concave; dorsal margin of pronotal fovea curves laterally from behind the eyes. Nodal furrow curves forward and is less than its length removed from the membranal suture, the nodal furrow may be slanting forward with only its tip curved forward. Apices of front and middle tibiae of the males prolonged into a long triangular shaped eminence of its anterior margin. Anterior tibia of males concavely indented just before the apex. First tarsal segment of the male front leg curved posteriorly with its anterior and posterior margins convex and concave respectively. First tarsal segment of the male middle leg convex on its anterior margin, posterior margin straight. The hind femora of both sexes with an indentation

on its anterior or outer margins near the base. Mesotrochanter angulate. Metaxyphus with basal lateral margins concave and diverging; apical oblique lateral margins concave and meeting in a pointed apex. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	131	38	13
Male middle leg	100	100	31	19
Female front leg	100	104	42	19
Female middle leg	100	93	33	20

Location of Types: Holotype ♂, allotype ♀, 3♂♂ and 5 ♀♀ paratypes, Guadalcanal, November 2, 1944, L. J. Lipovsky, in the Snow Entomological Collections.

Comparative Notes: Somewhat smaller but of the same shape and coloration as the darker forms of **E. abbreviata** (Kirby). However, the males of **E. gibbera** lack the patch of black spicules as found on the ventral surface of the mesotrochanter of the males of **E. abbreviata.** The males of **E. abbreviata** lack the triangular extensions of the anterior margins of the front and middle tibiae as found on **E. gibbera.**

Data on Distribution: Known only from type series.

Enithares congoensis n. sp.
Plate III, figure 16

Size: Length 6.7 mm. to 7.5 mm.; width of pronotum 2.5 mm. to 3 mm.

Color: Variable, reddish brown and dark forms. **Dark forms:** eyes brown speckled with black; vertex flavus or light brown; pronotum with its anterior half same color as vertex, posterior half appears black as it is hyaline and allows the black color of the underlying anterior margin of the scutellum to be seen; scutellum black, may be tinged with green at its apex; hemelytra black with hyaline longitudinal areas on the basal half of the corium and clavus. **Reddish brown form:** eyes reddish brown; vertex same color; pronotum with its anterior half black or dark brown, posterior half reddish brown; scutellum black; basal half of hemelytra orange with clavus having thin brown band bordering the scutellum and hemelytral commissure, apical half of the hemelytra dark brown or black with the exception of the clear zone of the membrane which is light brown. Both forms have legs stramineous.

Structural Characteristics: As viewed from above the anterior outline of the head is rounded; anterior width of the vertex less than its length; synthlipsis narrow, less than one-half as wide as the anterior width of the vertex; along the median longitudinal axis the head is equal to or longer than the length of the pronotum. Pronotum at least three times as broad as its median length; posterior margin concave; dorsal margin of pronotal fovea directed laterally from behind the eyes. Nodal furrow slants forward and less than its length removed from the membranal suture. First tarsal segment of the male front leg thickened dorsally at its base. Mesotrochanter

rounded. Metaxyphus with basal lateral margins convexly curved, apical oblique lateral margins concave and meeting in a pointed apex. Male genital capsule as shown on Plate III, figure 16. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	108	32	18
Male middle leg	100	87	33	31
Female front leg	100	111	33	22
Female middle leg	100	80	32	25

Location of Types: Holotype ♂, allotype ♀, 1 ♀ paratype, Buta, Belgian Congo, purchased fr. Dr. O. Staudinger, Feb. 1912, in the Snow Entomological Collections; other paratype: 2 ♂♂, 3 ♀♀, Lake Onango, French Congo, A. C. Good, in the Carnegie Museum.

Comparative Notes: This species is about the same size as **E. blandula.** Signoret. However, it lacks the black spicules as found on the anterior tibia of the latter. The male genital capsules are also greatly different, the clasper of **E. congoensis** is long, with its base swollen and the lateral margins narrowing to an acuminated apex which lies almost at the level of the dorsal margin of the posterior lobe, the clasper of **E. blandula** is short and ovoid in shape. **E. blandula** does not have the base of the first segment of the male front tarsi thickened.

Data on Distribution: In addition to the type series.

Africa

Stanleyville, Congo, August 8, 1909, Land Chopin, 2 ♀ (S.E.C.).

Enithares pellucida n. sp.
Plate III, figure 17

Size: Length 9 mm.; width of pronotum 3.3 mm.

Color: Eyes brown, dark brown, or gray; vertex may be white or tan; pronotum with anterior half same color as the vertex, posterior half hyaline and appears black as it overlies the black anterior portion of the scutellum; scutellum black with two lateral triangular shaped stripes, one on each side, meeting in the apex to form a "V", or it may be entirely stramineous with only the anterior margin black; hemelytra white or stramineous and partly or wholly hyaline; legs stramineous; abdominal venter dark brown with lateral margins and keel light brown or the abdominal venter may be gray.

Structural Characteristics: As viewed from above the anterior outline of the head is rounded with the anterior width of the vertex equal to or less than its length; synthlipsis wide, being at least one-half the anterior width of the vertex; along the median longitudinal axis the head is less than or equal to the median length of the pronotum. Pronotum with its width slightly less than three times its median length; posterior margin concave; dorsal margin of the pronotal fovea curves laterally from behind the eyes.

Nodal furrow slanting forward and less than its length removed from the membranal suture. Anterior tibiae of both sexes with a band of black spicules on the posterior surface. Mesotrochanter rounded. Metaxyphus with basal lateral margins almost straight and parallel; apical oblique lateral margins concavely curved and meeting in a long pointed apex. Male genital capsule as shown on Plate III, figure 17. The relative lengths of the parts of the legs are as follows:

	Femur	Tibia	1st. Tar. Seg.	2nd Tar. Seg.
Male front leg	100	104	36	19
Male middle leg	100	84	34	20
Female front leg	100	113	40	22
Female middle leg	100	81	36	19

Location of Types: Holotype ♂, allotype ♀, 1 ♂ and 2 ♀♀ paratypes, Tananarive, Madagascar, 1921, R. Decary, in the Snow Entomological Collections; 2 ♂♂ and 3 ♀♀ paratypes, same place, collector and date, in the Paris Museum.

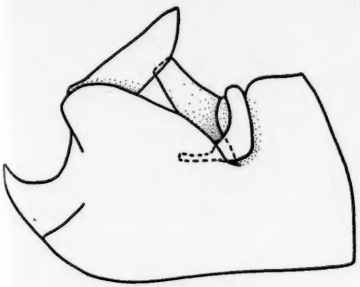
Comparative Notes: This species closely resembles **E. rhodopsis** Hutchinson, which appears to be confined to the mainland of Africa whereas this species is Madagascan. These two species are so similar that morphologically the male genital capsules are the best means of separating them. The posterior lobe of **E. pellucida** has its anterior margin slanting downward while that of **E. rhodopsis** is curved downward. The claspers are also shaped differently. That of **E. pellucida** has a more or less ovoid base with its apex curved forward while that of **E. rhodopsis** is ovoid in shape and not differentiated into a basal and apical region.

Data on Distribution: In addition to the type series.

Madagascar

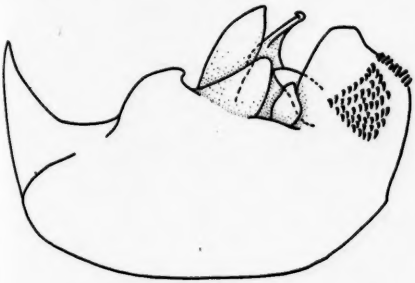
Sikora, 1896, 1 ♂, 3 ♀♀ (P.M.).

Madagascar, P. Cambque, January 13, 1914, 1 ♀ (U.S.N.M.), purchased fr. Prof. C. Lamberton, November 1913, 3 ♂♂, 3 ♀♀ (S.E.C.).



1. E. STRIDULATA N. SP.

2. E. METALLICA N. SP.



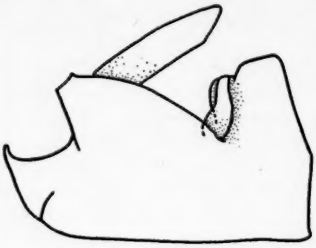
3. E. BAKERI N. SP.

4. E. MALAYENSIS N. SP.

5. E HUNGERFORDI N. SP.

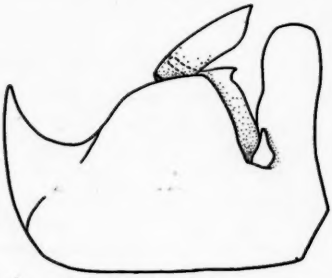
PLATE I

1. Lateral left view of the male genital capsule of **Enithares stridulata Brooks.**
2. Lateral left view of the male genital sapsule of **Enithares metallica Brooks.**
3. Lateral left view of the male genital capsule of **Enithares bakeri Brooks.**
4. Lateral left view of the male genital capsule of **Enithares malayensis Brooks.**
5. Lateral left view of the male fienital capsule of **Enithares hungerfordi Brooks.**

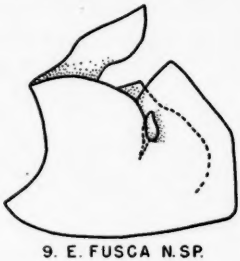


6. E. CHINENSIS N. SP.

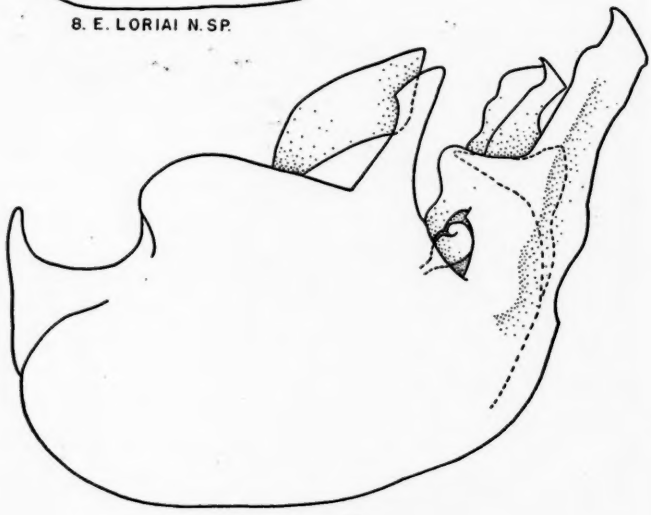
7. E. BUHLERI N. SP.



8. E. LORIAI N. SP.



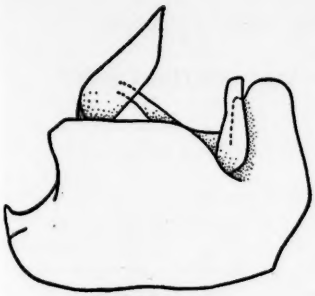
9. E. FUSCA N. SP.

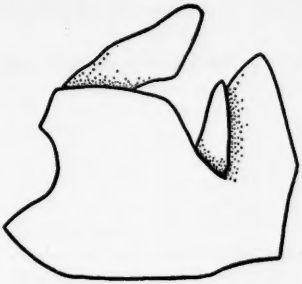


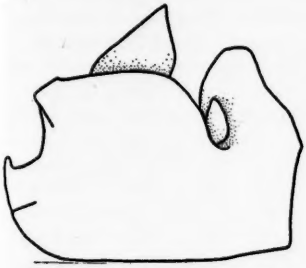
10. E. WALLACEI N. SP.

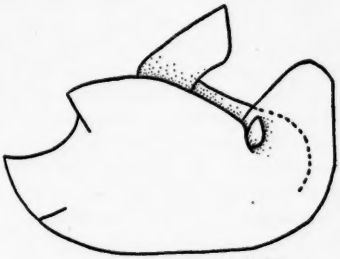
PLATE II

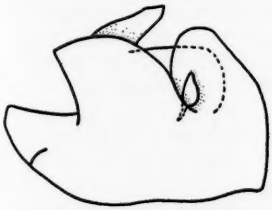
11. Lateral left view of the male genital capsule of **Enithares chinensis** Brooks.
12. Lateral left view of the male genital capsule of **Enithares buhleri** Brooks.
12. Lateral left view of the male genital capsule of **Enithares loriai** Brooks.
14. Lateral left view of the male genital capsule of **Enithares fusca** Brooks.
15. Lateral left view of the male genital capsule of **Enithares wallacei** Brooks.

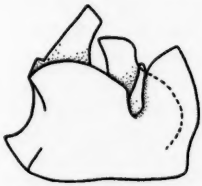












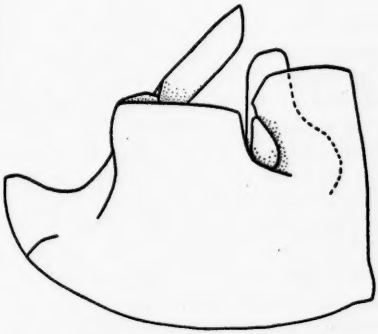


PLATE III

11. Lateral left view of the male genital capsule of **Enithares atra** Brooks.
12. Lateral left view of the male genital capsule of **Enithares freyi** Brooks.
13. Lateral left view of the male genital capsule of **Enithares fruhstorferi** Brooks.
14. Lateral left view of the male genital capsule of **Enithares timorensis** Brooks.
15. Lateral left view of the male genital capsule of **Enithares gibbera** Brooks.
16. Lateral left view of the male genital capsule of **Enithares congoensis** Brooks.
17. Lateral left view of the male genital capsule of **Enithares pellucida** Brooks.

REARING TECHNIQUE FOR WHITE GRUBS[1]

FLOYD D. MINER
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A rearing method for white grubs[2] has been developed at the University of Arkansas which makes it possible to study the life history of isolated grubs at outside temperatures. The information secured by this method is quite complete, including habits of vertical migration. Growing plants are used as food, which adds reliability to the method.

The rearing cage consists of a section of glass tubing 22 mm. in diameter and about 24 inches long. (The length should correspond to the maximum soil depth expected of the species being reared.) The tube is closed at one end with a one-hole rubber stopper and then filled with soil to within an inch of the top. A grub is placed in the soil and the desired food plant is planted. The tube is then inserted nearly to its full length in a hole prepared in the soil of the rearing area. A snug fit should be made with the sides of the tube. This hole is ordinarily made by driving a section of water pipe into the soil. A portable shelter is placed over the tubes in rainy weather. Notes are taken by pulling the tube from the soil and making inspection through the glass. In a majority of cases the grub will be visible, at least after the first instar is passed. Care is exercised in returning the tube to the same depth.

The rearing routine is essentially as follows. Eggs are secured from adults confined in one-litre battery jars of soil which are kept sunk in the soil out-of-doors, protected during rainy weather by a cellophane shelter. Eggs are incubated in the insectary in pillboxes partially filled with packed soil. These are inspected every other day and the moldy or infertile eggs removed.

When about to hatch, the remaining eggs are placed singly in shell vials with soil and food. The egg is placed in the bottom of a tilted vial, causing the egg to lie against one side of the vial. A pinch of soil is then dropped onto the egg. With practice this can be done in such a manner that the egg remains visible through the glass. On this soil a pinch of ground "Grapenuts" is then placed, spreading it out to cover the soil so that the hatching grub is surrounded by a food supply. Then a generous amount of soil is added and rye grass seed is planted. No stoppers are used. Watering is done sparingly. Eggs are examined daily through the glass and dates of hatching recorded.

After hatching, the young grubs are held in these vials for one week after which they are removed to the permanent outside tubes. These are withdrawn from the soil periodically and the depth of the grub and stage of development noted. When the food plant is killed, another is planted. When the adult is ready to emerge, the soil is smoothed so that the first emergence can be detected and a cork stopper is placed on the tube to confine the beetle.

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[1] Research paper No. 859, Journal Series, University of Arkansas. Published with the permission of the director of the Arkansas Agricultural Experiment Station.

[2] The genus **Phyllophaga** is especially referred to.

One of the merits of this method is that the grubs develop at a normal range of temperatures. It has been found that the temperature in the tube is a duplication of normal soil temperature if the tubes fit the holes tightly.

Moisture content of the soil is not nearly so well controlled, of course. A certain amount of water will enter the bottom of the tube; for the most part, however, watering is manual. For those species reared so far, soil moisture apparently has little effect within wide extremes, so that watering is governed almost entirely by the needs of the food plant.

Plants make surprisingly good growth in these tubes. Corn produces a heavy root growth in a week or two, and has been used as a standard. While such plants possibly are not altogether comparable nutritionally to field-grown plants, and are often consumed before the seedling stage is passed, they represent at least an approach to the natural food of the grubs. This is important where accuracy is desired since artificial foods may have a pronounced influence on an insect's life cycle.

Field observations have supported the accuracy of the information on seasonal history obtained by this method, insofar as such a check is possible. Adult emergence from tubes, for instance, occurs during the period of field emergence.

One weakness of the method is that the egg stage and the first week of the larval stage are spent indoors. This practice is followed because large numbers are reared through the first instar, as a precaution against any unusual mortality. Starting such a surplus by out-of-door methods would involve a prohibitive amount of time and equipment. The error introduced is probably small, since this represents a very small part of the total life history.

A compromise is also made with regard to food during the early part of the first instar. The use of the commercial breakfast food, "Grapenuts," as reported by Reinhard (1940), apparently decreases mortality during the first instar. This product is used, therefore, as a "starter" during the first week. After being transferred to the outside tubes the grubs are fed altogether on growing plants.

Although only **Phyllophaga** and **Cyclocephala** species have been reared so far in this type of cage, it should prove useful for many soil-inhabiting insects.

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Reinhard, H. J., 1940. The life history of **Phyllophaga lanceolata** (Say) and **Phyllophaga crinita** Burmeister. Jour. Econ. Ent. 33: 572-8.

DDT IN JUNIPER MEALY BUG CONTROL

LAVERE A. CALKINS*

Iola, Kansas

DDT, in wettable powder form, or technical DDT with a wetting agent (a wax-like aerosol) added, proved to be most efficient in the control of the juniper mealy bug, **Pseudococcus juniperi** Ehrhorn, in experiments at Pratt, Kansas, during the summer of 1945.[1] Reinspections of sprayed trees in September, 1945, January, 1946, and April, 1946, showed complete eradication of the pest on trees sprayed a single time in 1945. These trees have been examined at intervals during the past year and were still found free of juniper mealy bug. DDT was used at the rate of 6.65 ounces of actual DDT (approximately 5 per cent by weight) to one gallon of water. While very effective, this was objectionable in leaving a heavy white residue on the trees.

A water suspension of approximately .5 ounce of technical DDT (.4 per cent by weight) with an aerosol wetting agent was tried in Wichita in July, 1945, as well as a .4 per cent and a 2 per cent of DDT oil emulsion. Results in these tests were unsatisfactory. A heavily infested tree at Pratt was dusted in August, 1945, with 50 per cent wettable powder, and a re-examination in April, 1946, revealed little control of the mealy bug.

On May 16, 1946, the writer and Mr. Dale Allen, at that time Farm Bureau Agent of Cowley County, applied a spray consisting of 8 ounces (approximately 3 per cent by weight) of 50 per cent DDT wettable powder plus approximately one-third ounce of 40 per cent nicotine sulfate (Black Leaf 40) per gallon of water to three heavily infested trees at Winfield. A power sprayer of 150 gallons capacity was employed in the spraying and apparently, to date, the one application has given complete kill except on one large native tree which could not be satisfactorily covered. The large amount of powder used resulted in some stoppage of the spray nozzles.

In July, 1946, two property owners in Wichita sprayed a number of trees at their residences with a formula, suggested by the writer, consisting of 8 ounces (approximately 3 per cent by weight) of 50 per cent DDT wettable powder plus 4 teaspoons (slightly less than .6 ounce) of Black Leaf 40 per gallon of water. To date only one tree has shown reinfestation and that appeared on new growth which was immediately resprayed with complete success.

During the summer of 1946 a third property owner in Wichita, unable to use the concentration of DDT suggested (8 ounces 50 per cent wettable powder) in his spraying equipment, made three applications of greatly reduced strength and eradicated the mealy bug.

Early in the summer of 1946 a survey of Winfield disclosed a spread of the juniper mealy bug. The city purchased a small spray outfit and took over the task of spraying infested trees under the supervision of B. F. Quis-

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* Assistant to State Entomologist.

[1] Calkins, L. A., Journal of the Kansas Entomological Society, Volume 19, No. 2, April, 1946, pp. 66-69.

enberry, assistant to the writer. The formula used was 4 ounces of 50 per cent DDT wettable powder (approximately 1½ per cent by weight) plus 4 teaspoons Black Leaf 40 (approximately .6 ounce) to each gallon of water. Eradication of the pest was complete where full coverage was secured, but the spraying equipment was inadequate to reach the top of large trees and a further spread was noted in September, 1947. Again the city, using a larger sprayer, applied the DDT formula with excellent results when coverage was complete.

Late in February, 1946, the writer and his assistant, Jose Hidalgo, Jr., surveyed cedars in the city of Great Bend, finding several severe infestations. Mr. H. O. Schrepel, a local nurseryman, sprayed these properties during the following summer with the DDT-nicotine sulfate formula used at Winfield and obtained excellent results. Hot weather and little or no rainfall, ideal conditions for the development of the insect, prevailed during the summers of 1946 and 1947 and new infestations continued to develop. These were sprayed by Mr. Schrepel as they appeared and apparently were cleaned up.

On April 22, 1947, the writer treated one infested tree on each of two properties with a spray consisting of 4 ounces (approximately 1½ per cent by weight) of 50 per cent DDT wettable powder, plus 2 teaspoons of NNOR, a liquid containing rotenone, to each gallon of water. Two gallons of material were used on one tree and one and a half gallons on the other, the applications having been made by means of a three-gallon compressed air sprayer. The following day two additional tests of like character were set up, the formula being changed to 2 ounces of the 50 per cent DDT in one case and one ounce in the other, with two gallons of material used per tree. On the day following a hard rain which fell on April 24, the residual DDT was still evident. On June 28, August 11, September 22, October 1, and November 22 these properties were reinspected and no reinfestation had appeared. New growth was excellent, considering the extreme dryness of the summer.

An experiment on two heavily infested red cedars was made on September 22, 1947, in Wichita to determine if a small amount of material would eradicate the mealy bug. About two gallons of spray, consisting of 2 ounces of 50 per cent DDT wettable powder plus 2 teaspoons of NNOR per gallon of water, were applied to the two trees. On November 22 an examination disclosed no further damage, but a small number of live adults and numerous crawlers or nymphs was present. There were large numbers of parasitized adults, the larvae of the parasite, probably a chalcid wasp, appearing to be alive. It is hoped that observations in the spring and early summer of 1943 will show that the parasites may be able to overcome the remaining mealy bugs.

While the use of DDT in the strengths employed by the writer makes spraying for juniper mealy bug an expensive control, the results appear to justify the expense.

The attack of **Pseudococcus juniperi** Erh. on red cedar varieties has been persistent and in many cases very swift to cause great damage to beautiful and valuable trees. During the past summer the writer observed several

instances of damage to cedars which had very probably been infested at the time of planting and had only become noticeably damaged during the past season. The length of time since planting varied from several months to as long as eight or nine years. Natural enemies and unfavorable weather conditions no doubt play important roles in holding back damage by this insect, but given suitable conditions for development, the mealy bug can speedily ruin valuable evergreens. In localities where juniper mealy bugs are known to be present, the writer feels that protective spraying, as well as eradicative measures, should be undertaken.

Summary

The juniper mealy bug can be eradicated from heavily infested trees of the red cedar varieties by the use of 4 ounces (approximately 1½ per cent by weight) of 50 per cent DDT wettable powder plus 2 teaspoons of NNOR (a commercial material consisting of a synergistic wetting agent and a spreader, plus rotenone) to each gallon of water, applied as a spray, thoroughly wetting the trunk and foliage of the infested tree. For protective spraying it is suggested that only 2 ounces of the 50 per cent DDT wettable powder be used instead of the 4 ounces given for evident infestation.

A NEW LONATURA AND PARABOLOCRATUS (Homoptera-Cicadellidae)

R. H. BEAMER*

Lonatura teretis n. sp.

Resembles **Lonatura punctifrons** Beamer but easily separated from it by having a sinngle black spot on apex of crown and by the white band on apex of elytra of short-winged form. Length ♂ 2.5 mm; ♀ 3.2 mm.

Structure: Crown subconical, broadly rounded; elytra of brachypterous form about as long as head and pronotum, apices truncate, costal margin longest.

Color: General ground color stramineous; crown with three irregular margined black spots, one at apex, and a pair between this and eyes; elytra semihyaline with narrow white band on apices; dorsum of abdomen with basal half black, remainder of segment lighter, mostly white; pygofer with basal two thirds black, remainder buff; front with narrow black band between antennae strongly arched toward union with clypellus; venter of abdomen in female mostly light, in male segments dark with light outer border; valve dark brown, plates much lighter.

Genitalia: Female last ventral segment slightly less than twice as long as preceding, posterior margin with a shallow notch either side of middle; male

* Contribution from the Department of Entomology, University of Kansas, Lawrence, Kansas.

valve large, broadly rounded; plates almost as broad as long, evenly narrowed on outer margin to sharp apices; aedeagus with broad, thin flange on ventral margin of outer half, apex with a lateral retrorse process, slightly longer than width of shaft at tip.

Holotype ♂, allotype ♀, 46 ♀ and 53 ♂ paratypes, Rabbit Ear Pass, Colorado, August 5, 1947, R. H. Beamer. Types in the Snow Entomological Collections.

Parabolocratus hepneri n. sp.

Resembling **Parabolocratus atascaderus** Ball but smaller with dark color on dorsum of abdomen of both males and females instead of just a wedge on venter of males. Length ♂ 4.5-5-mm.; ♀ 6-7 mm.

Structure: Crown about one and one third times as wide between eyes as length at middle, flat, margin sharp, broadly rounded, apex forming considerably more than a right angle; elytra of most specimens reaching on to fourth abdominal segment in female, almost to pygofer in male; pygofer in male on ventral margin enlarged beyond base with distinct, sharp notch just before middle, narrowed beyond this to sharp apices.

Color: General color of dorsum greenish yellow. Male: vertex usually margined with darker, veins of elytra light brown; dorsum of abdomen dark brown except narrow hind margin of each segment light; venter more or less brown, front almost black; segments of abdomen dark brown except very narrow posterior border very light. Female: elytra with veins light brown; abdomen with a pair of broad, longitudinal, brown stripes beginning about apex of elytra and ending at apices of pygofers; venter stramineous, ovipositor, legs and front darker, front nearly black at union with crown.

Genitalia: Male plates long, slender, flaring on outer third, apices sharp; valve short, angular; aedeagus in dorso-ventral view with shaft long and straight, sides very slightly narrowed to apical sixth where it suddenly narrows to apical width, apex divided into two narrow, parallel-margined recurving processes.

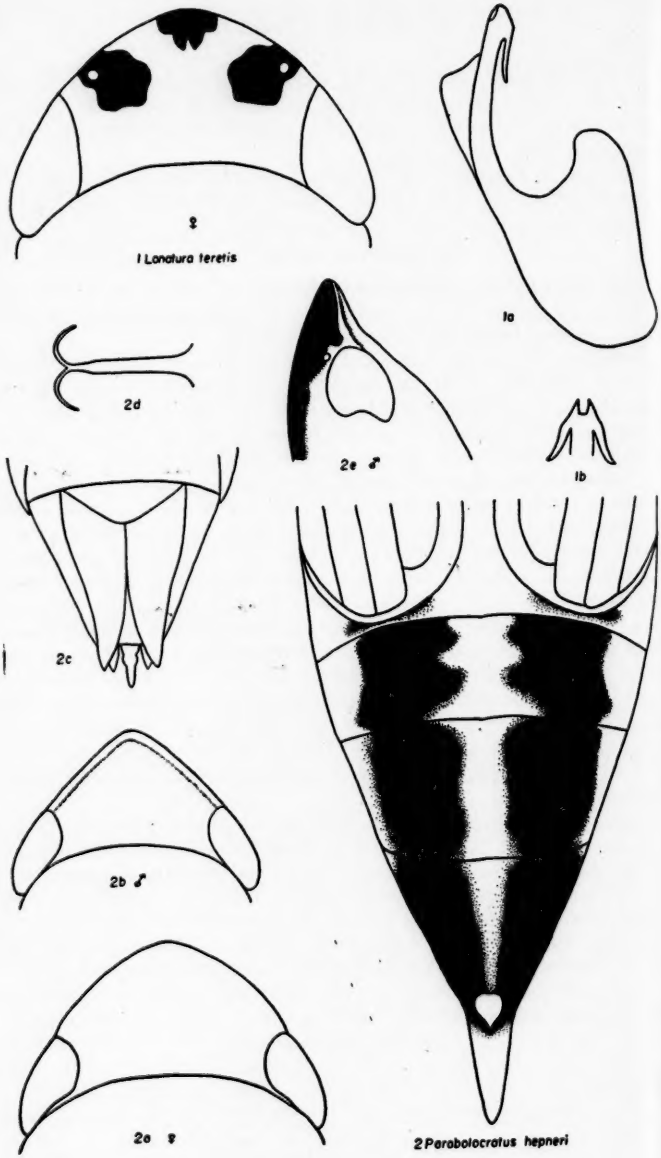
Holotype ♂, allotype ♀, 32 ♂ and 48 ♀ paratypes, Garden City, Kansas, June 12, 1946, R. H. Beamer. Types in Snow Entomological Collections.

The above specimens were taken from **Calamivilfa longifolia** Hack where they were closely attended by rather large reddish ants. In fact, the easiest way to locate the leafhoppers was to select a stem of the above grass with these red ants running about on it. The leafhoppers were laying eggs, row upon row of them, in the leaf sheaths at the base of the leaves.

I take great pleasure in naming this leafhopper for Doctor Leon Hepner who is tremendously interested in the taxonomy of the Cicadellidae.

EXPLANATION OF PLATE

1. Dorsal view of head of female **Lonatura teretis** Beamer.
1a. Lateral view of aedeagus of **Lonatura teretis** Beamer.
1b. Dorso-ventral view of tip of aedeagus of **Lonatura teretis** Beamer.
2. Dorsal view of abdomen of female of **Parabolocratus hepneri** Beamer.
2a. Dorsal view of head of female of **Parabolocratus hepneri** Beamer.
2b. Dorsal view of head of male of **Parabolocratus hepneri** Beamer.
2c. Ventral view of male genital capsule of **Parabolocratus hepneri** Beamer.
2d. Dorso-ventral view of aedeagus of **Parabolocratus hepneri** Beamer.
2e. Lateral view of head of male of **Parabolocratus hepneri** Beamer.


♀
1 Lonatura teretis
1a
2d
2e ♂
1b
2c
2b ♂
2a ♀
2 Perabolocratus hepneri

RECORDS OF THREE SPECIES OF DYTISCIDAE NEW TO THE UNITED STATES (Coleoptera)

HUGH B. LEECH

California Academy of Sciences, San Francisco

The specimens upon which the following records are based were recognized as new to the United States list, and were submitted to Mr. J. Balfour-Browne of the British Museum for identification. He compared them with Sharp's types. I am indebted to him, and to Mr. J. W. Green for permission to give notice of the **Laccophilus** he took in Arizona.

Laccophilus apicalis Sharp

Laccophilus apicalis Sharp, 1873, Ent. Mo. Mag. 10(3):53; Sharp, 1882, Sci. Trans. Roy. Dublin Soc. (2) 2:291; 1882, Biol. Centr.-Amer., Coleopt. 1(2):10; 1887, op. cit. 1(2):749.

Described from Nicaragua, and known from Guatemala, Panama, and Mexico. It resembles **L. fasciatus** Aubé and strongly marked examples of **terminalis** Sharp, but is broader than the former, with the postmedian dark elytral fascia a third again as wide. In the male the interspaces of the metacoxal file are narrower than the impressed lines and convex, not broad and flat as in the other two species.

Bear Canyon, Tucson, Ariz., March 26, 1946 (J. W. Green).

Laccophilus confusus Sharp

Laccophilus confusus Sharp, 1882, Sci. Trans. Roy. Dublin Soc. (2)2:292; 1882, Biol. Centr.-Amer., Coleopt. 1(2):11; 1887 op. cit. 1(2):749.

Previously known from Mexico. A small species, resembling **proximus** Say and small examples of **terminalis**, but narrower than either and dark beneath. The metacoxal file of the male is reduced, very lightly impressed, with the interspaces flat and comparatively broad.

Bear Canyon, Tucson, Ariz., March 18 and 26, 1946 (J. W. Green).

Copelatus debilis Sharp

Copelatus debilis Sharp, 1882, Sci. Trans. Roy. Dublin Soc. (2) 2:579; 1882, Biol. Centr.-Amer., Coleopt. 1(2):37.

Described from Nicaragua and Guatemala; recorded in the literature from Brazil, Panama, and Mexico. A small, narrow species which traces to couplet 3 in Schaeffer's key (1908. New York Ent. Soc., Jour. *16*(1):17). It will not fit either choice there, since there are but five discal striae on each elytron.

Brownsville, Texas, November 18, 1932 [Armstrong]; Brownsville, Tex., July 24, 1942 (E. S. Ross).

THE RELATION OF TEMPERATURE IN THE SUSCEPTIBILITY OF GRASSHOPPERS TO SYNTHETIC INSECTICIDE DUSTS[1]

W. C. RHOADES AND CHARLES H. BRETT

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Introduction

Considerable variation in the effectiveness of synthetic insecticide dusts has appeared in reports of experiments conducted in different areas. The probablity that temperature was one of the important factors resulted in the carrying out of tests under different controlled temperatures as reported in this paper.

Materials and Methods

Adults of the differential grasshopper, **Melanoplus differentialis** (Thomas), the two-lined grasshopper, **M. bivittatus** (Say), and the lesser migratory grasshopper **M. mexicanus** (Sauss.) were collected in the field during October, 1946, brought into the laboratory and used as a source of egg supply. Care was taken to select vigorous females for this purpose. These grasshoppers were held in screen wire cages (10"x14"x18") in which five 4-ounce jars filled with moist sand were placed. Eggs were deposited readily in these jars. After deposition they were stored in a refrigerator at 40° F. for a period of at least two weeks. They were then placed in an incubator at a constant temperature of 80.6° F. Grasshoppers hatching from these eggs were reared to the adult stage on head lettuce and used as test insects. Some tests were made with adult and nymphal grasshoppers collected directly from the field.

Laboratory tests were made with dusts containing 5 percent gamma benzene hexachloride, 20 percent chlorinated camphene (3956), 10 percent chlordan, 20 percent DDT and 2 percent parathion (3422).

Ten grasshoppers were placed in a common two-quart fruit jar. A piece of screen wire was cut, fitted into the ring of the jar lid and used as a cover. A small hole the size of a lead pencil was punched in the screen cover to allow a V-shaped glass tube of the same diameter to be placed in the jar for applying dust to the grasshoppers. Fifty milligrams of dust were put into the glass tube and allowed to settle in the bottom of the "V." A rubber bulb was attached at one end of the tube. The open end was inserted through the opening in the screen cover. One vigorous squeeze of the rubber bulb forced all dust into the jar and distributed it evenly. After five minutes the grasshoppers were transferred to a small screen cage (6"x6"x10") where food was available, and then placed in a constant tem-

[1] A portion of a thesis presented by the senior author in partial fulfillment for the Master of Science degree at the Oklahoma Agriculture and Mechanical College, Stillwater, Okla., July, 1947.

perature compartment. The temperatures used in these tests were 70° F., 80° F., 90° F., and 100° F. Observations were made at 2, 4, 8, 24, 48, and 72 hour intervals. For some of the tests, observations were made over a longer period of time. Some fumigation tests were made by inverting screened jars containing grasshoppers over jars containing insecticidal materials and sealing them together with adhesive tape.

Results

Grasshoppers treated with 5 percent gamma benzene hexachloride were affected and killed more quickly as temperatures became progressively higher (Table 1). The best results were obtained at 100° F. At this temperature all individuals were dead by the end of 24 hours. At other temperatures all grasshoppers treated with benzene hexachloride died or were affected.[2] Those which were not killed recovered, copulated, and produced viable eggs.

Chlorinated camphene showed a temperature relationship, but the difference in susceptibility at high and low temperatures was less than for benzene hexachloride. It was also slower acting. Maximum mortality was not reached until at the end of 72 hours when all individuals were dead except 15 percent of the differential grasshoppers at 70° F.

Chlordan also showed a relation to temperature, being slightly more toxic at the higher temperatures. One hundred percent mortality did not occur with **M. differentialis** or **M. bivittatus** at any of the four temperatures, but all migratory grasshoppers, **M. mexicanus**, were dead at the end of 48 hours at 100° F.

DDT did not give high percentage kills. In contrast to the other insecticides, grasshoppers appeared to be more susceptible at the lower temperatures. A maximum mortality of 60 percent occurred at 70° F. after 72 hours on lesser migratory grasshoppers.

Parathion showed a definite temperature relationship. Two-lined grasshoppers treated with 2 percent dust and placed in the constant temperature compartments were affected in greater numbers or killed more quickly as the temperatures became progressively higher. The best results were obtained at 90° F. and 100° F. At these temperatures all individuals were dead at the end of 8 hours. This relationship was also evident in large scale field tests run at high and low temperatures in Oklahoma.[3]

Table 2 shows little difference between the susceptibility of the three species of grasshoppers to the synthetic insecticides. Increased susceptibility at high temperature may be partially due to the fumigation action of certain of the insecticides. This was more pronounced with benzene hexachloride and parathion than with chlordan and chlorinated camphene. Benzene hexachloride showed definite fumigating action. High temperature apparently increased the rate of gaseous release from this chemical.

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[2] Grasshoppers were considered to be affected when they stumbled about showing loss of co-ordination accompanied by nervous tremors.

[3] Results submitted for publication in the Journal of Economic Entomology.

TABLE I

Relation of temperature in the susceptability of three economic species of grasshoppers, **Melanoplus differentialis**=(Dif.), **M. bizittatus**=(Biv.), and **M. mexicanus**=(Mex.) to synthetic insecticides applied as contact dusts.[1]

Insecticide	Hours after Treatment	Percent Mortality — Constant Temp. Degrees F. 70			80			90			100		
		Dif.	Biv.	Mex.	Dif.	Biv.	Mex.	Dif.	Biv.	Mex.	Dif.	Biv.	Mex.
Gamma Benzene Hexachloride, 5 percent	4	0	20	0	5	10	0	15	40	20	40	60	50
	8	0	30	10	10	50	20	40	70	40	75	90	90
	24	80	100	80	90	100	100	100	100	100	100	100	100
	48	80	100	80	90	100	100	100	100	100	100	100	100
	72	80	100	80	90	100	100	100	100	100	100	100	100
Chlorinated Camphene, 20 percent	4	0	0	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	10	10	5	0	20	0	0	30
	24	50	60	70	50	70	80	80	90	90	75	90	90
	48	80	90	90	75	90	100	100	100	100	100	100	100
	72	85	100	100	100	100	100	100	100	100	100	100	100
Chlordan, 10 percent	4	0	0	0	0	0	0	0	0	0	0	0	0
	8	10	0	0	10	0	10	20	10	20	20	20	30
	24	50	50	40	50	50	60	60	60	50	70	70	90
	48	70	70	70	70	70	70	80	80	70	80	80	100
	72	70	70	80	80	80	80	80	80	90	80	80	100
DDT, 20 percent	4	0	0	0	0	0	0	0	0	0	0	0	0
	8	0	0	0	0	0	0	0	0	0	0	0	0
	24	20	20	20	20	20	20	10	20	20	0	0	20
	48	40	40	40	40	40	40	20	30	30	10	20	30
	72	50	50	60	40	40	40	30	30	40	30	30	30
Parathion, 2 percent	4		15			40			50			35	
	8		75			80			90			100	
	24		95			100			100			100	
	48		95			100			100			100	

[1] Each entry in table represents 10 replicates of 10 insects each.

Uvarov (2)[4] states that the influence of temperature plays an important part in the respiratory movements of grasshoppers. These movements increase from an average of 5.9 per minute at a temperature of 9.5° C. (49.1° F.) to 26.6 per minute at a temperature of 26.6° C. (79.88° F.).

Krogh (1) studied the composition of the air in the tracheal system of the hind leg of a grasshopper and found that the oxygen percentage may be as high as 20 percent during rest but after exhausting muscular exercise it is reduced to 5 percent. Thus, if the insecticide is applied at high temperatures where grasshopper activity is greatest, more of the toxic gas may be taken in to replace oxygen than when grasshoppers are comparatively inactive at low temperatures.

DDT does not act as a fumigant. It is slow in its action and is taken up by absorption through the fatty tissues. The grasshoppers are sluggish at low temperatures and the rate of metabolism slower. Perhaps this reduces the rate at which DDT is eliminated and thus allows a lethal concentration to be reached more quickly.

A good contact dust for grasshopper control should act quickly in order that further damage by the insects may be prevented. Residual qualities are desirable for continued control throughout the hatching period or to kill grasshoppers which migrate into the area. Low toxicity to warm blooded animals is very important and low cost in the application of the insecticide is of prime importance. Not all of these features are fully realized as yet in the use of any of the synthetics but a great step forward has been made in grasshopper control.

Summary

Laboratory tests were made on three economic species of grasshoppers, **Melanoplus differentialis, M. bivittatus,** and **M. mexicanus mexicanus** to determine their susceptibility to certain synthetic insecticide dusts under different constant temperatures.

Two percent parathion and five percent gamma benzene hexachloride were the most effective materials tested. The parathion dust was more rapid in its action, reaching peak kill in 8 hours at 100° F. as compared to 24 hours for benzene hexachloride. Increase in temperature reduced the time required to reach peak mortality and increased the percentage of grasshoppers killed by these materials. Fumigating action was very evident with benzene hexachloride.

Twenty percent chlorinated camphene and ten percent chlordan were slower acting, requiring from 48 to 72 hours to reach peak mortality. High temperature increased their effectiveness to a lesser extent. Chlordan was less effective than the other materials except DDT, in its action as a contact toxin.

Twenty percent DDT dust was somewhat more effective at the lower temperatures. This material was slow acting and did not give high percentage mortalities.

[4] Numbers in parenthesis refer to literature cited.

There was little difference in the relative susceptibility of the three kinds of grasshoppers to the different insecticides. (Table 2).

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TABLE 2.

Comparative susceptibility of three economic species of grasshoppers to synthetic insecticides applied as contact dusts.

Insecticide	Average Percent Mortality of all Temperature Tests					
	Melanoplus differentialis		Melanoplus bivittatus		Melanoplus mexicanus	
	24 hrs.	72 hrs.	24 hrs.	72 hrs.	24 hrs.	72 hrs.
Benzene hexachloride, 5 percent gamma	98	92	100	100	95	95
Chlorinated camphene, 20 percent	63	96	77	100	82	100
Chlordan, 10 percent	57	77	57	77	80	85
DDT, 20 percent	7	37	15	37	20	42
Avg. for all treatments	55	75	62	78	64	80

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